



**SOLAR ENERGY**  
**TECHNOLOGIES OFFICE**  
U.S. Department Of Energy

Power Electronics Program Kickoff

# Multi-port Autonomous Reconfigurable Solar power plant (MARS)

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**Co-PI:** Madhu Chinthavali (*Business POC*)

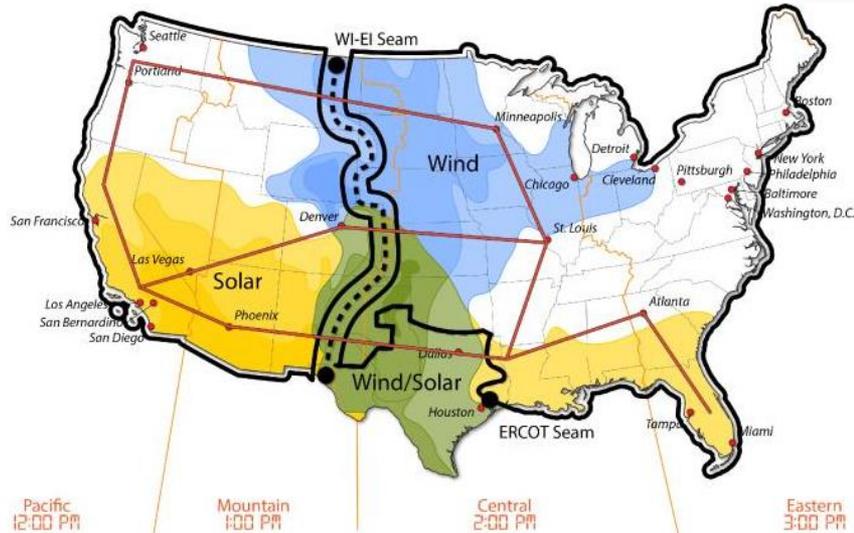
[energy.gov/solar-office](https://energy.gov/solar-office)

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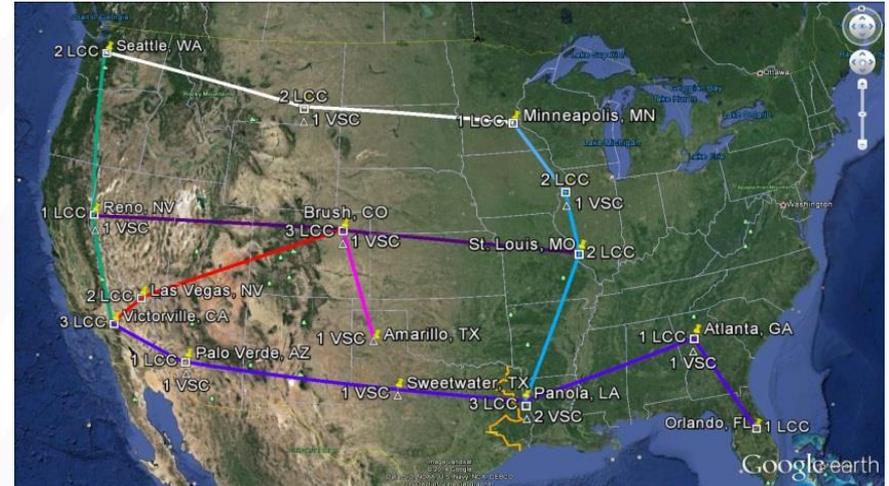
Suman Debnath, R&D Staff, ORNL

# Project Background

- Large-scale penetration of solar, HVdc, energy storage resources planned or in pipeline
- Discrete development of HVdc, solar, and energy storage



Connecting Eastern & Western Interconnections

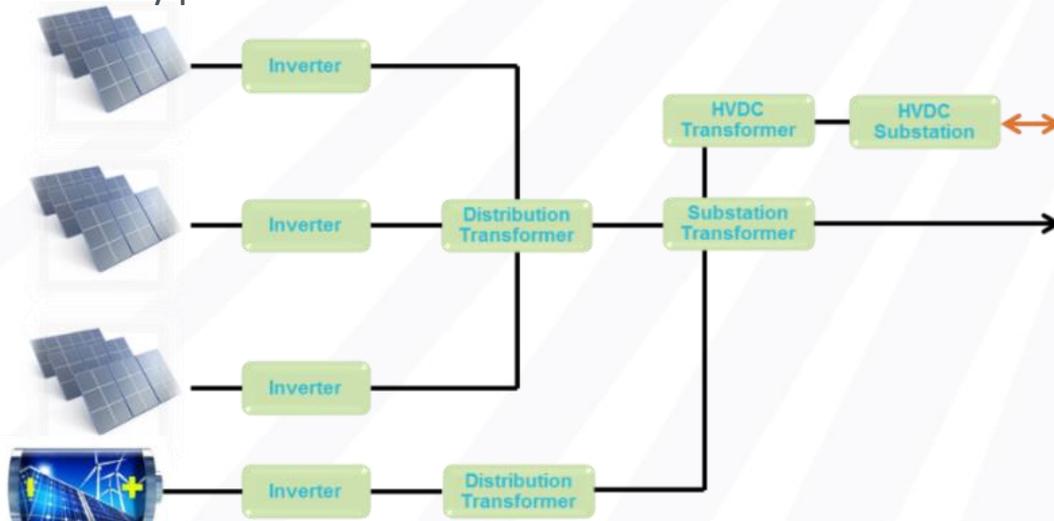


Connecting Eastern Interconnection, Electric Reliability Council of Texas, Western Interconnection

# Project Overview

**Problem Statement:** Discrete development of power electronics for solar plants, energy storage systems, high-voltage dc (HVdc) leads to

- Increased costs
- Reduced reliability
- Reduced efficiency
- Competing controls
- Transient stability problems



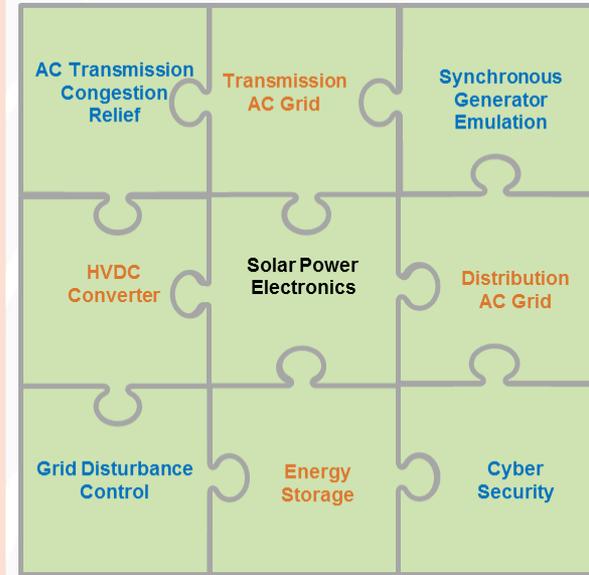
# Project Overview and Objectives

**Project Objective:** Develop integrated power electronics to interface utility-scale solar power, energy storage, dc, and ac systems with advanced grid services.

**Project Outcomes:** Modular, multi-purpose power electronics (PE) enabling value-added grid solar energy services.

## Technical Outcomes:

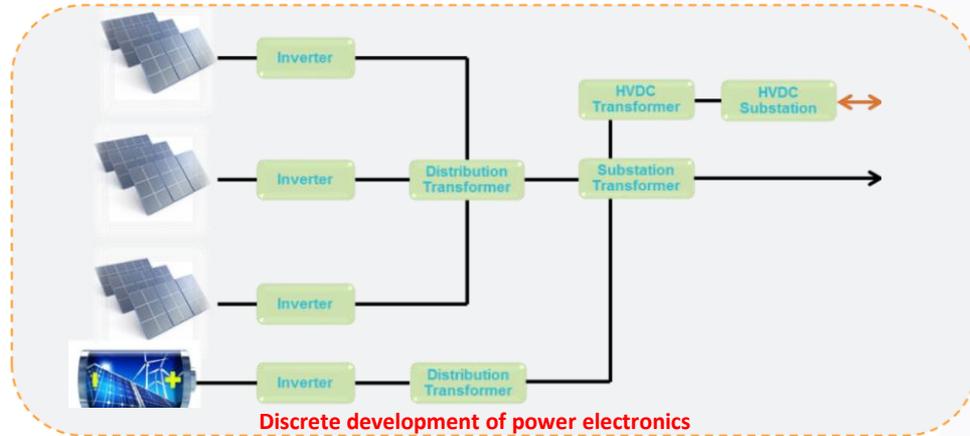
- Reduced costs and losses than the discrete development.
- Provide primary and secondary frequency response improvement, congestion relief, and disturbance control rejection.
- Harmonized control approach to manage the solar, energy storage, and dc transmission that further improves the transient stability.



**Modular PE solution**

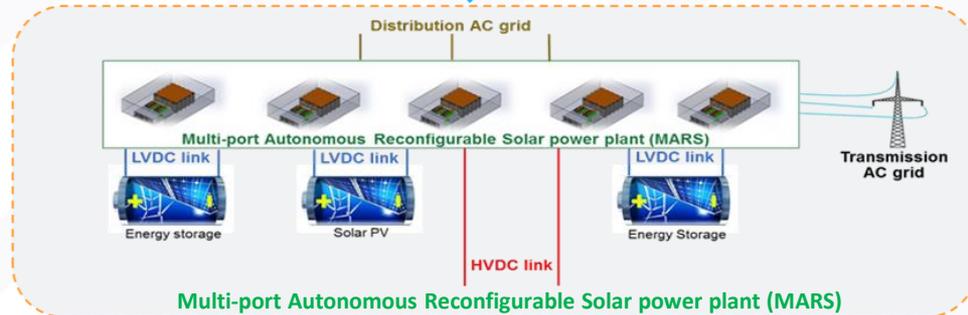
# Overall Approach: Integrated Solution

*Integrated system approach similar to laptops (vs. desktop)*



Discrete development of power electronics

Reduced power electronic and transformer interfaces : reduces cost by up to 50% , reduces losses by up to 50%



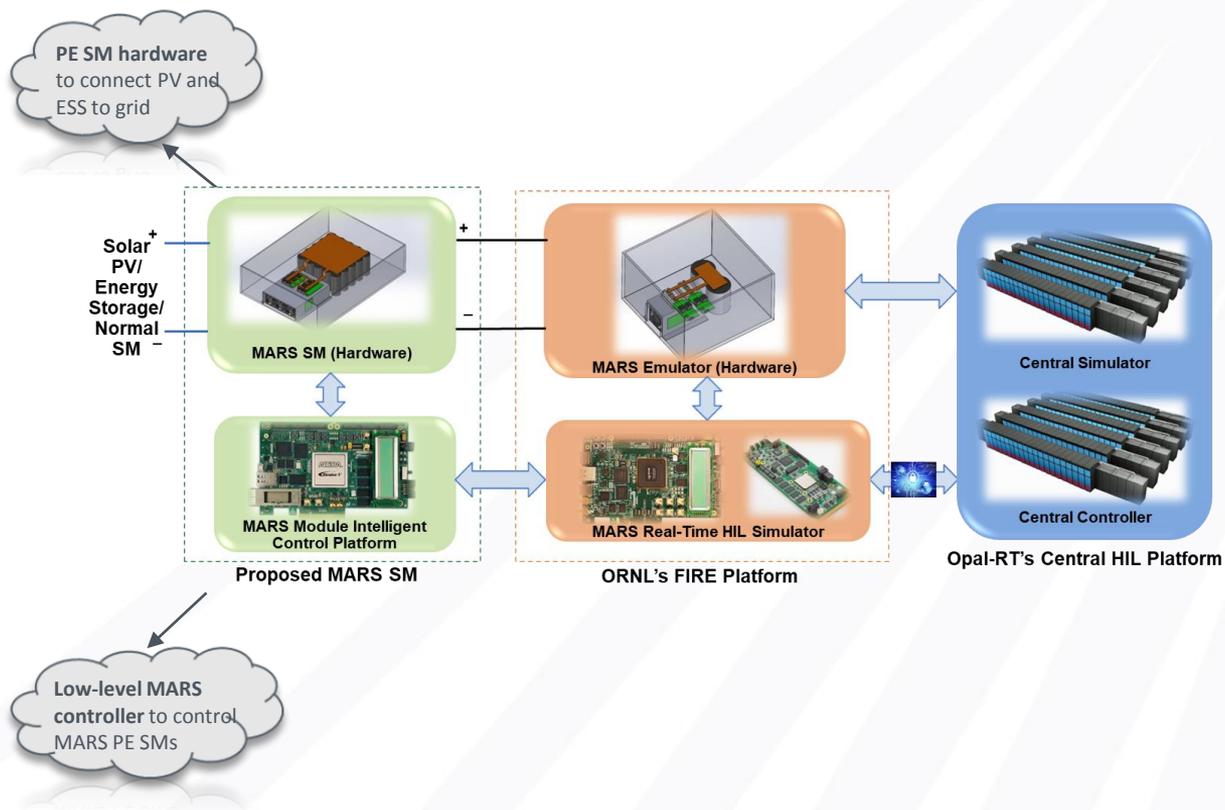
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# Project Team

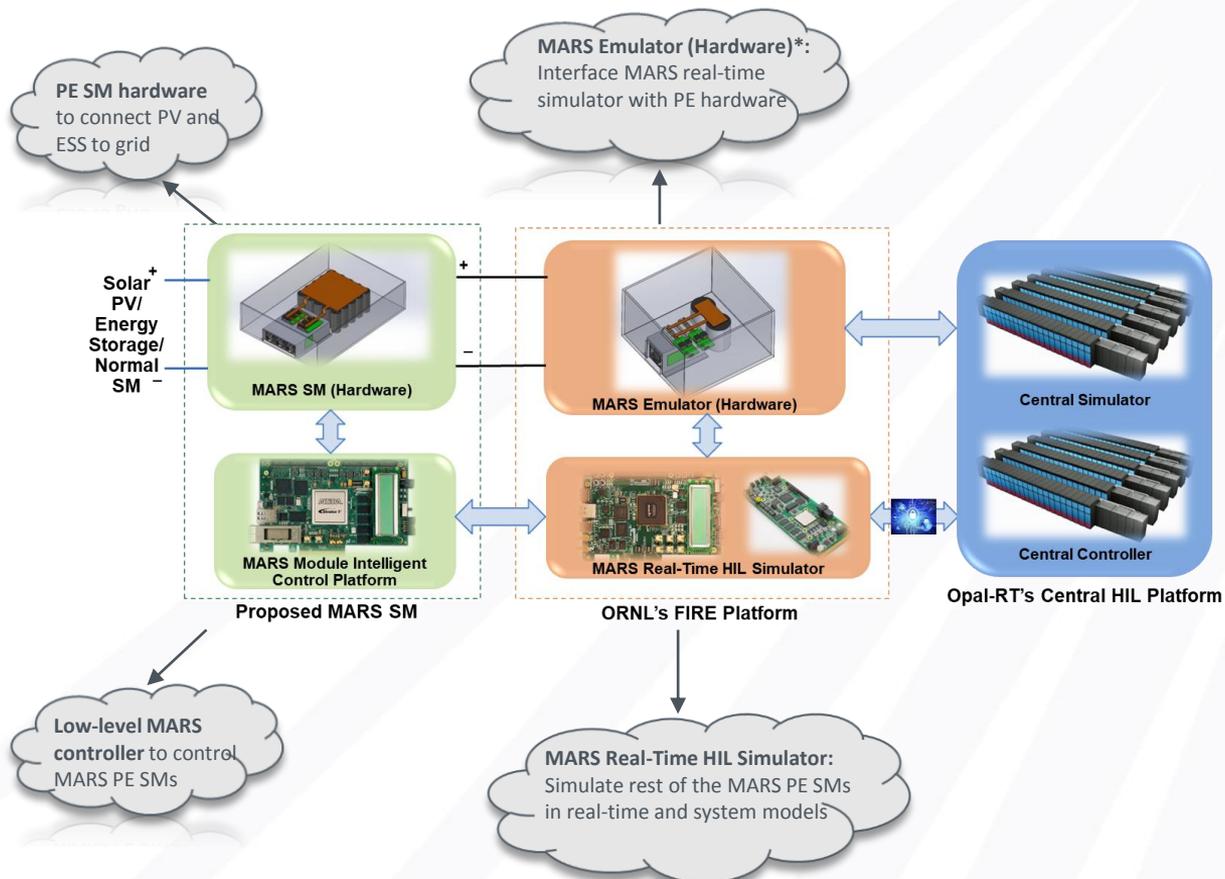
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- Key Project Participants
  - ORNL
  - ABB
  - Georgia Institute of Technology
  - Opal-RT
  - Entergy
  - Southern California Edison

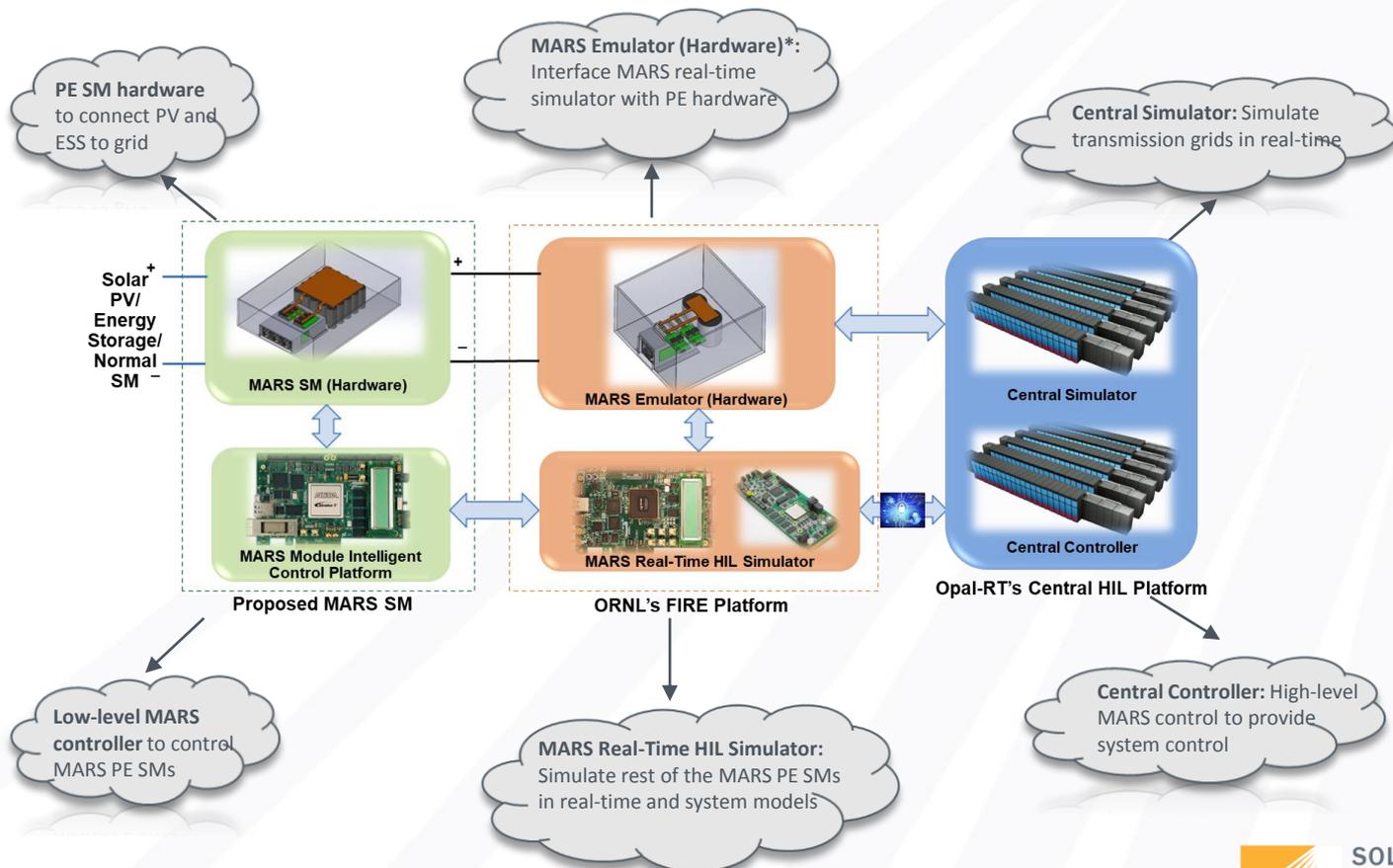
# Technical Approach: Power Electronic Hardware-in-the-Loop (PE-HIL) Emulation Architecture



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Questions?